HEWLETT PACKARD

3421A Data Acquisition/Control Unit and 3056DL Data Logger

HP-IL

DESIGNED FOR HP-IB SYSTEMS

January 1983

When you want to know if it's moving, flowing, safe, corroding, drying out, heating up or simply on or off. . .use the new Hewlett-Packard 3421A Data Acquisition/Control Unit to get the facts. The HP 3421A is the small system that beats the big price of data logging.

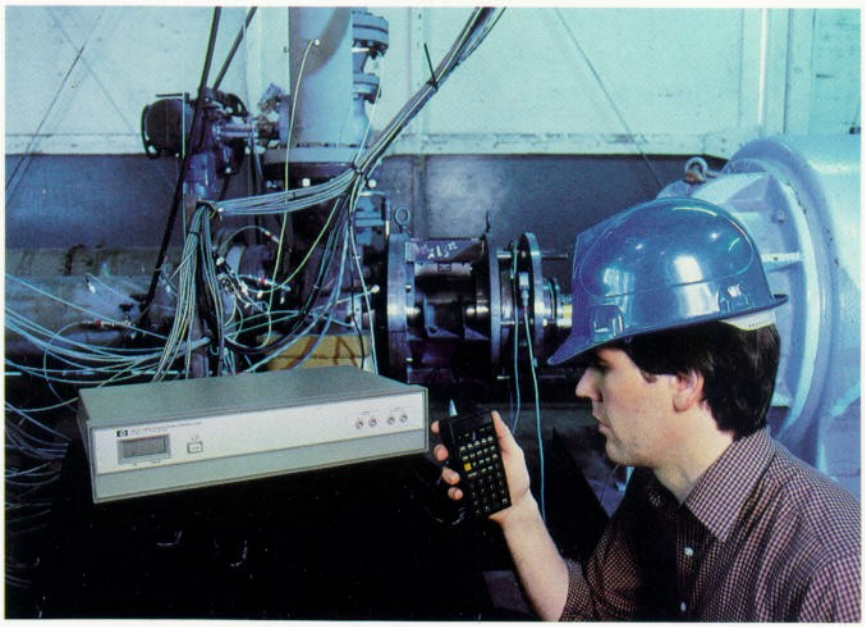
Now you can justify that small data acquisition project, with a system that will quickly pay its own way.

The HP 3421A Mainframe scans 30 channels, measures dc volts, ac volts, both 2 and 4-wire ohms, frequency and temperature. It also reads and writes digital information and stores up to 30 analog readings. The standard 3421A comes with an HP-IL interface, so it can be controlled by a 41CV handheld calculator or an HP 85 desktop computer. An optional HP-IB interface is available for use with more sophisticated computers, such as the HP 9826A or 9836A.

When combined with the HP 85F computer and special-purpose software, the 3421A forms the heart of a data logging system called the 3056DL – a menu-driven data logger.

As your needs progress from those of a simple data logger to a more complex data acquisition and control system, the 3056DL answers the challege with subroutine software and advanced instrument commands. The 3056DL blends easy-to-use menu programming for the beginner with advanced features for the expert – all at a very low price.

Now you can have choice without compromise – 3421A/41CV for portability or the 3056DL for low cost bench applications. Despite their computational power, both systems have programming aids that make data logging as easy as answering a few questions – so you can be taking data immediately instead of learning a programming language. The

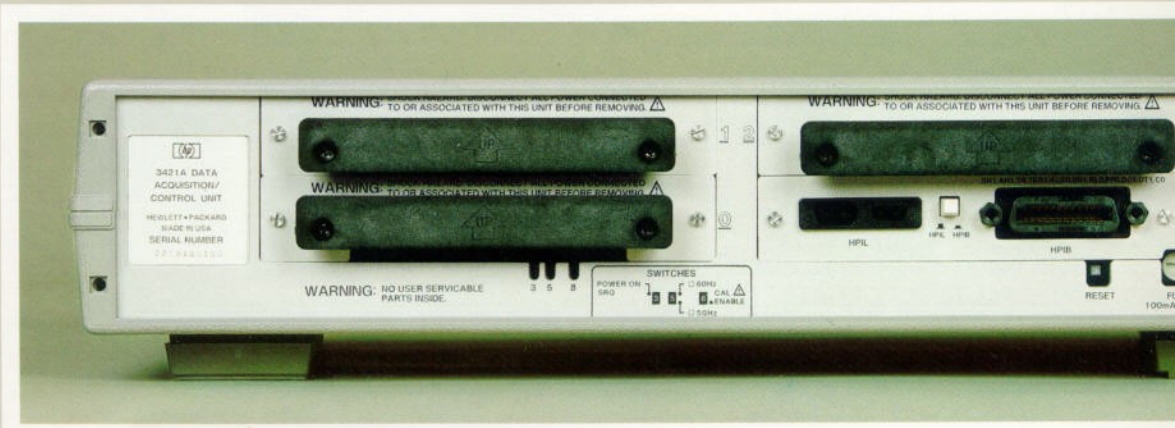


3421A and 3056DL have all the attributes of much more expensive data acquisition system:

- **Measurement Integrity**
- **System Portability**
- **Computational Power**

The HP 3421A Data Acquisition/Control U

The 3421A is an excellent low-cost front end that can be used with any HP-IB or HP-IL



Three slots for any combination of: • Breadboard card, • Digital assembly, or • Relay

t. . . use it with an HP 41CV for low-cost data logging

mputer.

embly.

Display shows channels closed, digital states and self-test conditions so you can see what's happening at a glance.

Electronic calibration and self-test mean high reliability and repeatable answers.

Built-in thermocouple reference junction.

Built-in 300,000 count A/D with 1 μV sensitivity and good noise rejection – so you can measure transducers with confidence.

Front terminals are in parallel with the scanner's common bus. You can use them to measure dc volts, ac volts, ohms, frequency or thermocouples conveniently on the bench.

Two custom keyboards and a special ROM transform the HP 41CV into a low-cost, battery-powered system controller.

AC line power when you can get it, rechargeable battery power when you can't. "Sleep" mode for extended battery life.

Store 30 readings in the internal buffer for later use by the computer.

Switch from HP-IL to HP-IB for a choice between low battery power and high computer performance.

Scan up to 30 differential channels or 56 single-ended channels.

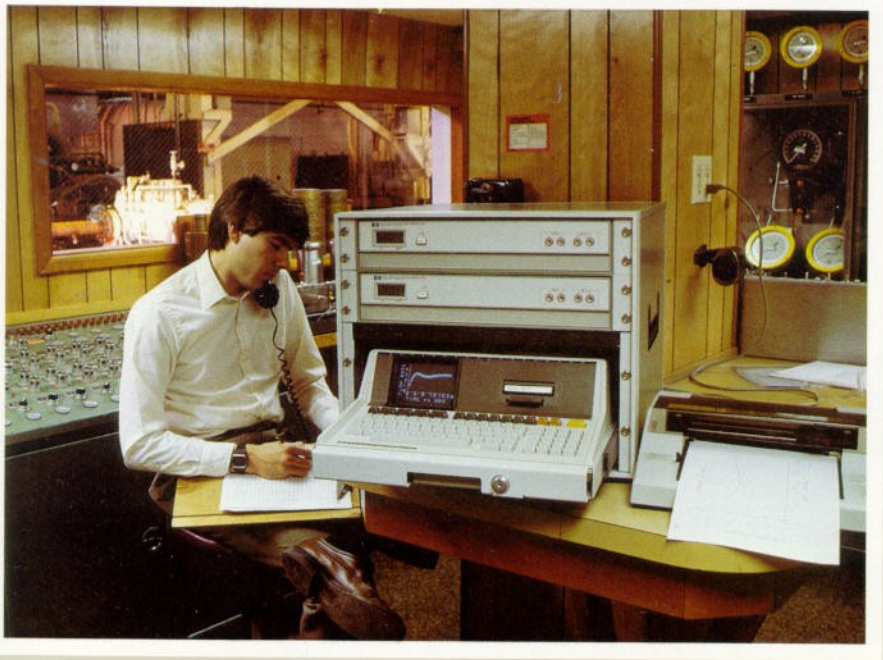
. . .or with an HP 85F for more system capability.

The 3056DL Data Logger

Using dedicated menu-entry software, the 3056DL merges the measurement skills of up to two 3421A Data Acquisition/Control Units with the computational power of an HP 85F Personal Computer. The result is a low-cost data logger with a surprising combination of talents: 5½ digit analog measurements, up to 60 differential channels, digital I/O, HP-IL or HP-IB,* graphic analysis, magnetic tape storage and two levels of programming. Choose the 3056DL for your next electronic workstation.

- **Menu Programming**
- **Subroutine Software**
- **Graphic Analysis**
- **Up to 60 Channels**

*HP-IB: Not just IEEE-488, but the hardware, documentation and support that delivers the shortest path to a measurement system.

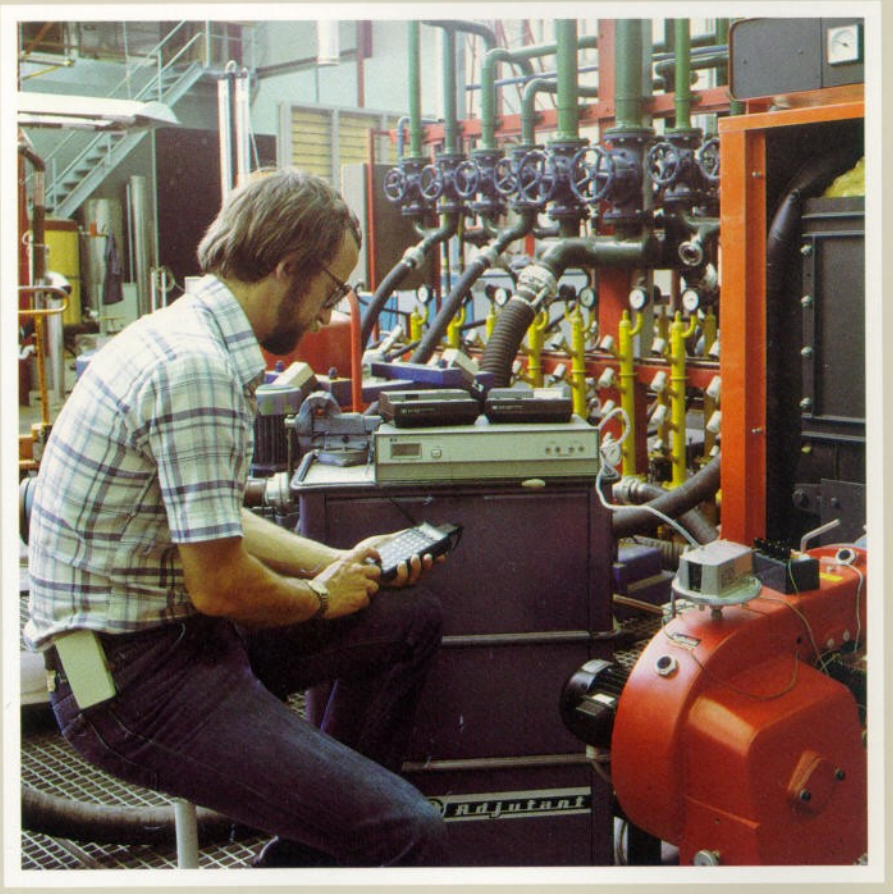


The 3421A/41CV and the 3056DL - two new systems that solve your application. . .

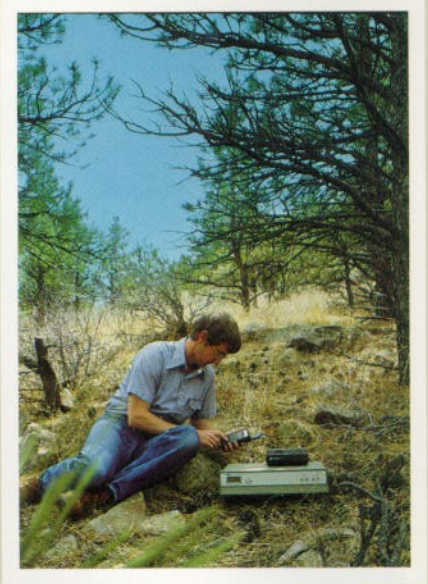
The Application

Monitor flow meter performance as a function of temperature and static pressure.

Measure the TEMPERATURE of a bridge section to tell the best time to resurface the bridge, or measure the galvanic effect on reinforcing rods buried inside concrete to predict the lifetime of the bridge.



Watch liquid LEVEL, flow rates and water temperature in a hatchery to produce the best mixture of stream water and well water for optimum fish growth.



Measure local soil temperatures in 30 locations to determine how clear-cutting of timber affects the seedling mortality in a forest.

reliable information from a low-cost, battery-powered system.

The Solution

Measurement Integrity

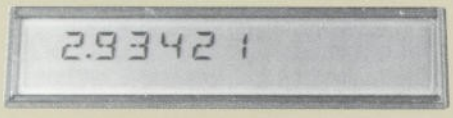
All of these applications have one thing in common: the data logger operator needs accurate reliable information. Whether you are trying to keep a school of fish alive or designing a flow meter, the test results are crucial. Since most physical transducers produce very low-level signals, you need a data acquisition system that does not compromise on measurement integrity.

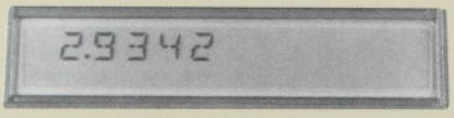
The 3421A has the accuracy, the resolution and the noise rejection you need for critical tests:

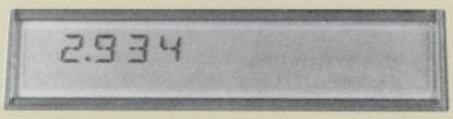
Full Scale Accuracy:	.01% DCV
Resolution:	300,000 counts
Sensitivity:	1 μV
Common Mode Rejection:	120 dB

The integrating A/D converter delivers the high noise rejection necessary for operation in an industrial environment.

You can even trade speed for accuracy. While the basic resolution of the A/D is 5½ digits, you can program it for 4½ or 3½ digits to increase the reading rate. Use the 5½ digit mode to uncover extremely small changes in process variables, or use the 3½ digit mode to measure over 30 readings per second.







Electronic Calibration

The 3421A has no manual calibration adjustments – no pots that can change value – no variable capacitors that move due to vibration inside the cab of the truck or under the bridge. All calibration constants are stored in a CMOS RAM and protected by a 10-year lithium iodide battery.

System Versatility

The HP 3421A does more than just measure; it also has digital inputs and outputs. Use the 3421A digital inputs in the fish hatchery to monitor level sensors, and use the companion digital output switches to sound an alarm when the water level gets too low.

For the timber study, use the special 3421A Control ROM with the 41CV handheld calculator. This Control ROM extends the versatility of the 3421A by adding special functions like thermistor and RTD linearization.

If you want to measure thermocouples, the 3421A makes it easy by providing a thermocouple reference junction on each analog multiplexer card. Thermocouple linearization for type T thermocouples is provided directly inside the 3421A. For other thermocouples (J,K,E,R,S), use the linearization routine in the 41C Control ROM.

System Portability

The 3421A not only has the measurement integrity of more expensive data acquisition units, but it also is compact, battery powered and has a "sleep" mode for extended battery life.

Low Power Sleep Mode

When you are at the end of a long, intermittent power line, or 15 miles from the ranger station, you will appreciate the "powerdown" command in the 41CV. This command tells the 3421A, the 82162A Printer, and the 82161A Digital Cassette Drive to "go to sleep" until the 82182A Time Module awakens them. In the sleep mode, only a fraction of a milliamp of battery current is consumed by the whole system. Use this extended battery lifetime to your advantage in forestry studies, weather stations, oil well monitoring, or any other activity where power is not immediately available. Where power failures are a common occurrence, the battery in the 3421A acts as an Uninterruptible Power Supply.

The System

The 3421A/41CV System is the low-cost alternative to beating today's high cost of acquiring data.

The complete system has:

- 41CV computer with 2.2K bytes of memory.
- 82160A HP-IL Module for serial communication.
- 82182A Time Module for system timing.
- 44468A Data Acquisition Pac with 3421A Control ROM and two keyboards to make the 3421A more versatile.
- 82161A Digital Cassette Drive with 130K bytes of storage.
- 82162A Printer/Plotter for quiet hard-copy records.

The 3421A Command Set

When you use the 41CV with the 3421A, the 3421A recognizes two types of instructions: standard and advanced. The standard instructions are high level commands designed for fast programming. You can specify either a single channel or an entire list. Here's an example. Say you want to make ac voltage measurements on channels 12 through 27. Simply enter.

alpha ACV 12-27 alpha

When you execute the OUTA (OUTput Alpha register) command, the 3421A will measure channels 12 through 27 sequentially and store those readings in its internal buffer. The IND (INput Decimal) command in the 41CV can then be used to read the numbers back.

Standard commands (ACV, DCV, BIT, etc.) make it easy to program any 3421A function. For advanced programming, another set of commands allows you to do things like turn off the auto-zero function, select range and many other functions that enable you to increase system reading rates.

Data Acquisition Pac

For programming that's even easier and more powerful, select the 44468A Data Acquisition Pac. It contains the 3421A Control ROM for the 41CV, a "Front Panel" and a "Data Logger" keyboard that transforms the 41CV into a hand-held instrument panel.

With the "Front Panel," you can access any 3421A function on any appropriate channel. For instance, press DCV, answer 15 for the channel, and the 41CV will display continuous dc voltage readings on the 41CV from channel 15 of the 3421A.

The "Data Logger" keyboard lets you scan a sequence of channels at a specified time interval. The time is monitored by an 82182A Time Module that can even keep track of real time when the 3421A and 41CV are "asleep." You use the Data Logger program by answering a series of questions that appear on the display of the 41CV.

The third and most flexible section of the 3421A Control ROM is the 3421A special instruction set. These powerful instructions minimize the amount of programming necessary.

program, measure, print, record. . .it's all there & it's easy.

The HP 41CV –

This pocket-sized problem solver is battery-powered and comes with an alphanumeric display, continuous memory, assignable keys and a family of accessories that transform it from a calculator into a handheld system controller.

The HP 82161A Digital Cassette Drive

Each of these battery-powered devices holds 131,000 bytes of information. The 82161A accepts the HP-IL powerdown command, and its precise tape control assures you of data integrity.

The HP 82162A Thermal Printer/Plotter

This 24-character plotter/printer also responds to the powerdown command. Use it simply as a printing device, or use the plotter mode visually to detect small changes in your experiment.

System Specifications – 3421A/41CV*

Reading Rates

These rates assume 30 readings taken on a fixed range with one function. Since the 3421A has a channel list which you preprogram, speeds are independent of channel sequence.

Reading rates include the scan time, A/D conversion time, and the time to transfer the reading into a 41CV register.

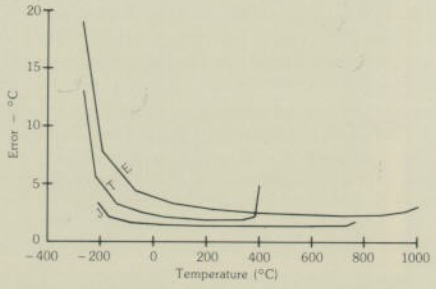
DVM Reading Rates (channels/sec)

	DCV,Ω	ACV	Frequency	Thermocouple Type T
5½ Digit	1.0	–	0.1	0.6
4½ Digit	1.9	0.3	0.6	0.6
3½ Digit	2.0	0.3	1.7	0.6

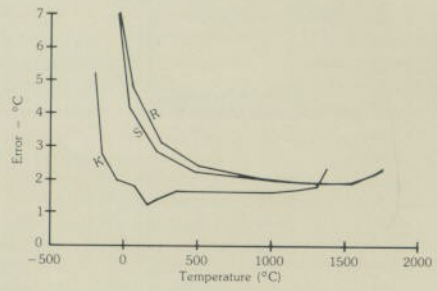
Temperature Accuracy

These errors include the linearization error of the 44468A Data Acquisition Pac, thermal offset voltages, A/D error and reference junction error. They do not include transducer error.

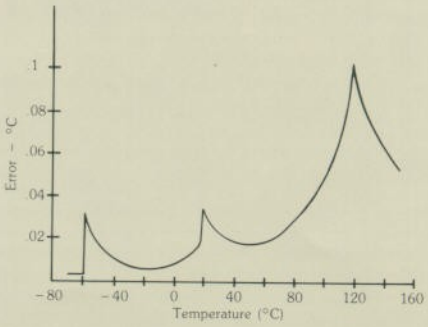
J,E,T Thermocouples



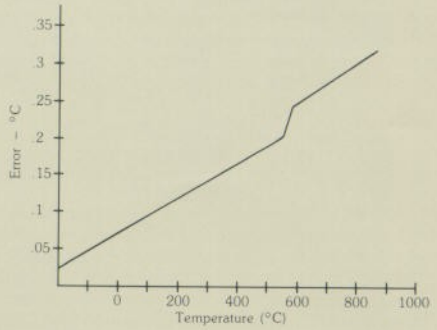
K,R,S Thermocouples



2.252 kΩ Thermistor



100 Ω Pt RTD α = .00385



*See page 15 for detailed specifications on the 3421A.

The Application

This circuit designer has a limited budget, but needs a system to monitor power supply drift on a new design. She has to monitor 50 thermistor channels, two ac voltages (including 240 volt line), line frequency and 26 dc voltages.

Measure thermocouples directly for engine and bearing temperatures while monitoring fuel flow rate and air intake velocity to maximize the efficiency of a diesel engine.

The owner of this greenhouse is a first-time computer programmer who wants to know the power consumption of the greenhouse as a function of glazing material, ambient temperature, solar radiation and wind velocity.

using the 85F Personal Computer for more programming flexibility.

The Solution

These complex applications demand more versatility from the system: from the computer, the instrument and the system software.

Computer and Software

The greenhouse owner will appreciate a computer with graphics and a menu-entry software package for an easy way to get started in data acquisition. The 85F, with a graphics printer and CRT, and the 3056DL Menu Software combine to make data logging as simple as answering a few questions on the screen.

Graphics

The 3056DL graphics package also helps the circuit designer visualize the experiment by drawing histograms of power supply drift, and by plotting series regulator voltage drop versus heat rise. The circuit designer can combine the 3056DL Measurement Subroutine Software with custom software to get optimum performance in complex operations. Whether you are an experienced programmer or a beginner, you can save time by using the 3056DL Software package.

Hard Copy

Meticulous, reliable records are a necessary part of flowmeter calibration and adhesive research. Count on the 85F to print these records on its 32-column printer or store them on magnetic tape for later retrieval. Data taken automatically and stored on a computer tape reduces the possibility of human recording error, and immediately produces a permanent record of the work.

The Instrument

The measuring instrument, the 3421A is of course the same for both the 41CV and the 85F system. But the 85F computer can take full advantage of the speed of the 3421A. Using the 41CV, the maximum reading rate including transfer time is 2/second. With the 85F, the speed increases to 11 readings/second, so you can spend less time on each experiment.

When using a 3421A with the HP-IB option, our circuit designer can make complex calculations on the 85F at the same time the 3421A is taking readings and storing them in its internal memory.

Single-Ended Scanning

The circuit designer can utilize another 3421A feature: Single-Ended Scanning. Each 3421A in the system can scan up to 30 independent channels, but if you can use one common connection on all the channels, you can measure up to 56 single-ended channels using a single mainframe. That reduces the price-per-channel of this low-cost system even further.

This is a project to study the effects of temperature and pressure on the bonding strength of adhesives. The adhesives are used to bond tiles to the space shuttle, and must be tested at very high temperatures.

The System

The 3056DL DATA LOGGER merges the measurement capabilities of up to two 3421A Data Acquisition/Control Units with the programming versatility of the HP 85F computer. It comes in an attractive locking cabinet with two dedicated software packages and all necessary cables. There is also a choice of interfaces: HP-IB for the 85F or HP-IL for the 85F Option 006.

Menu Programming

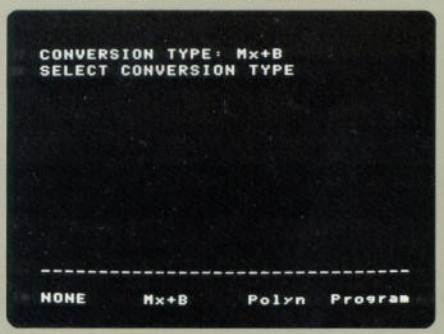
Two levels of software come with each 3056DL DATA LOGGER. The 3056DL Menu Software is ideal for the first-time user, yet powerful enough for an expert. Choose from no less than 17 separate functions:

- DCV
- ACV
- Digital Read
- Actuate
- 2-Wire RTD
- 4-Wire RTD
- 2-Wire Ohms
- 4-Wire Ohms
- Frequency
- 4 – 20 mA
- 2.2K Thermistor
- Thermocouples: J, K, T, E, R, S

Each function is selected simply by pressing the appropriate key on the HP 85F computer.

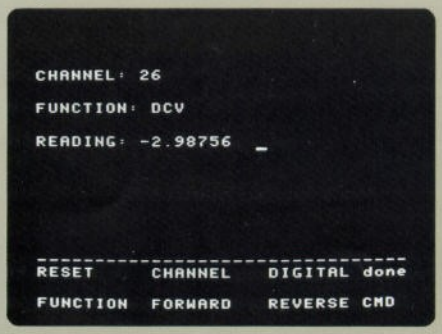
User Definable Functions

When the 17 available functions are not adequate for your purposes, you can generate your own linearization equation: mX + B, a 5th order polynomial, or even a BASIC subroutine that you write yourself. The 3056DL Menu Software provides remarkable latitude in solving difficult measurement problems.



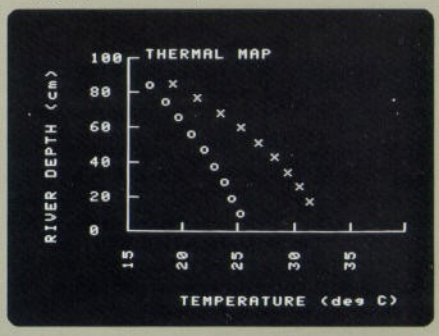
Startup

When you are starting or troubleshooting an experiment, the "Front Panel" program helps you check the setup. It converts the 85F keyboard into a multimeter panel so you can quickly measure voltage, resistance, temperature, frequency and digital information at a keystroke.



Analysis Tools

Once you have acquired the data, the 3056DL software can help you reduce it to meaningful information. Graphics software lets you look inside the data – to UNDERSTAND why the pump fails or the trees die. It's a wonderful way to gain insight that you sometimes miss when starting at a page full of numbers. The 3056DL has software to plot graphs and histograms to make your data logging task easy.



for easy start-up, measurement subroutines for advanced programming.

Adaptive Data Logging

When a specified channel exceeds its measurement limits, you can instruct the system to print or display a warning, or jump to a completely different measurement routine. For instance, you can scan slowly while the process you are monitoring is stable, and then adapt the scanning rate to follow the out-of-limit conditions on a few critical channels. This "adaptive scanning" philosophy makes efficient use of data storage space and computer time.

Naturally, a system that can do adaptive scanning can also set LO limits, HI limits and "hysteresis" or "deadband" limits.

```
LIMIT # 1

LIMIT TYPE: HIGH
LIMIT VALUE: 2.65348
LIMIT ACTION: ACTIVATE GROUP
GROUP: 20

EDIT        DONE
```

Basic Subroutine Software

For the BASIC programmer, there are measurement subroutines in the 3056DL software. Integrate these subroutines into your own programming material to get the optimum speed and efficiency from the data logger.

```
10 SUB "rtd" (R)
70 IF R>390.26 OR R<18.49 THEN R
=-9.E99 @ GOTO 250
80 R0=100
90 W=R/R0
110 IF W<1 THEN 190
130 P1=3367.82144088
140 P2=13065764.8633
150 P3=-1723543.60565
170 R=P1-SQR(P2+P3*W) @ GOTO 250

190 P0=-241.996759172
200 P1=222.560617915
210 P2=25.2488238815
220 P3=-5.81268262546
```

The Computer

The powerful HP 85F personal computer can help you solve complex scientific problems with its advanced BASIC language. You can also use it for financial justifications and data analysis.

It has a built-in tape drive for data storage, a CRT and user definable keys for menu entry, and a printer for hard-copy graphics. It's all in one package – compact and lightweight for easy portability. The HP 85F is the ideal control and analysis tool for data acquisition.

Use the 85F with either the 82937A HP-IB interface or the 82938A HP-IL interface to communicate to the 3421A Data Acquisition/Control Unit.

The 85F also has a large library of useful applications software. Choose from a BASIC Training Pac, Linear Programming, Electrical Engineering, General Statistics and more.

The Graphic Advantage

With a graphics computer such as the 85F, you can communicate ideas in a small space and gain insight into your application.

- Detect small changes
- Visualize a process
- Reduce tables to a single picture

System Specifications - 3056DL*

These rates assume 30 readings taken on a fixed range with no function change. Speeds are independent of channel sequence. Rates include scan time, A/D conversion time and the time to transfer the reading to the 85F. Rates apply for either HP-IB or HP-IL.

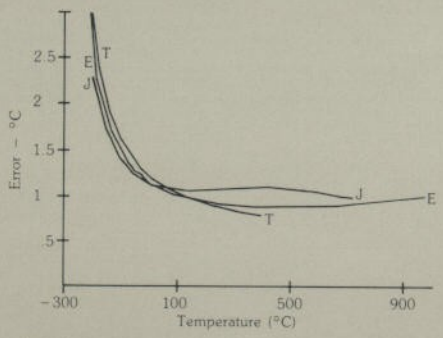
DVM Reading Rates (readings/second)

	DCV,Ω				
	Auto Zero Off	Auto Zero On	ACV	Frequency	Type T Thermocouple
5½ Digit	3.2	1.8	–	0.1	0.9
4½ Digit	9	8	0.3	0.8	0.9
3½ Digit	11	10	0.4	5.8	0.9

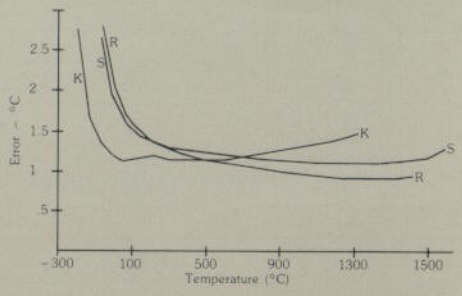
Temperature Errors

These errors include the linearization error of the 3056DL software, thermal offset voltages, A/D error and reference junction error. They do not include transducer errors.

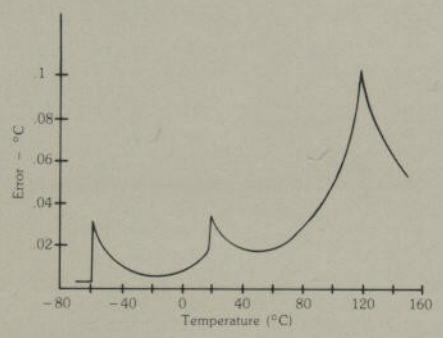
J,E,T Thermocouples



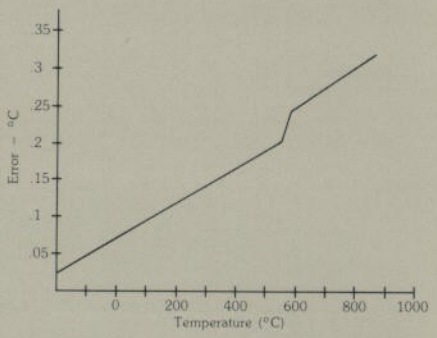
K,R,S Thermocouples



2.2 kΩ Thermistor



100 Ω Platinum RTD α = .00385

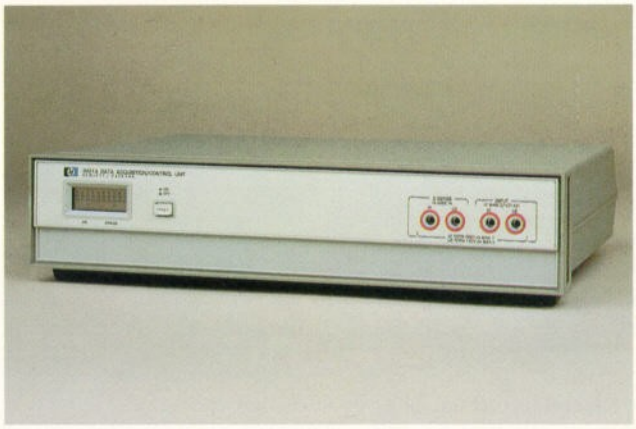


*See page 15 for detailed specifications on the 3421A.

3421A Mainframe Specifications

The 3421A has an integrating 5½ – 4½ – 3½ digit multimeter, a frequency counter and thermocouple compensation all built in. It measures Vdc, Vac, Ω, frequency and temperature. All specifications are for relative humidity ≤85% at 30°C. See operating manual for 95% 40°C specifications.

Internal buffer capacity: 30 readings
Channel display: LCD 30 channels plus power and error indicators
Electronic calibration enabled by rear panel switch
Front terminals connected to multiplexer common



DC Voltage

Range	Maximum Display (5½ digit)	5½ Digit Resolution	Input Resistance ≤30°C, 85%RH	5½ Digit *Accuracy ± (%Reading + Counts) 23°C ± 5°C 90 Days	1 Year	Temperature Coefficient ± (%Reading + Counts)/°C (0 – 18°C, 28 – 55°C) 5½ Digit	4½ Digit	3½ Digit
0.3 V	.301000	1 μV	≥10^{10}Ω	.009 + 6	.02 + 6	.0008 + .5	.0008 + .05	.0008 + 0
3 V	3.01000	10 μV	≥10^{10}Ω	.009 + 3	.02 + 3	.0008 + .05	.0008 + 0	.0008 + 0
30 V	30.1000	100 μV	10 MΩ ± 1%	.009 + 3	.02 + 3	.0008 + .5	.0008 + .05	.0008 + 0
300 V	301.000	1 mV	10 MΩ ± 1%	.009 + 3	.02 + 3	.0008 + .05	.0008 + 0	.0008 + 0
Auto								

*For 4½ and 3½ digits, change number of counts to 1.

Noise Rejection: For noise of 50 or 60 Hz ± 0.1%, 1 KΩ unbalance in low lead. Autozero on

	5½ Digit	4½ Digit	3½ Digit
AC NMR	80	59	0
AC ECMR	140	120	60
DC CMR:	140 dB		

Maximum Input Voltage:
± 350 V peak Hi-earth, Hi-Lo or between any two terminals within the instrument
± 150 V peak Lo-earth

Resistance

The 3421A makes 2-wire or 4-wire measurements, with either 5½, 4½ or 3½ digit resolution.

Range	Maximum 5½ Digit Reading	5½ Digit Resolution	Measurement Current ± 2.7%	Accuracy 5½ Digits ± (%Reading ± Counts) 23°C ± 5°C 90 Days	1 Year	Temperature Coefficient (%Reading + Counts)°C 0 – 18°C, 28 – 55°C 5½ Digit	4½ Digit	3½ Digit
300 Ω	301.000	1 mΩ	1 mA	.012 + 6	.017 + 6	.0009 + 0.5	.0009 + .05	.0009 + 0
3 KΩ	3.01000	10 mΩ	1 mA	.011 + 3	.016 + 3	.0009 + .05	.0009 + 0	.0009 + 0
30 KΩ	30.1000	100 mΩ	100 μA	.011 + 3	.016 + 3	.0009 + .05	.0009 + 0	.0009 + 0
300 KΩ	301.000	1 Ω	10 μA	.011 + 3	.016 + 3	.0009 + .05	.0009 + 0	.0009 + 0
** 3 MΩ	3.01000	10 Ω	1 μA	.014 + 3	.018 + 3	.0021 + .05	.0021 + 0	.021 + 0
** 30 MΩ	30.1000	100 Ω	100 nA	.12 + 3	.12 + 3	.021 + .05	.021 + 0	.0021 + 0
Auto								

**Add .07% Reading (3 MΩ Range) and 0.7% Reading (30 MΩ Range) when using the 3½ digit mode.

Measurement accuracy is for 4-wire mode, 5½ digits, auto zero on. For 4½ or 3½ digits, use number of counts = 1. For 2-wire mode, add a maximum of 4Ω offset.

Non-destructive overload: ± 300V peak

Maximum Open Circuit Voltage: 6.5 volts

Mainframe Specifications (cont'd)

AC Volts

The 3421A has 3 and 30 volt ac ranges. For convenient ac line voltage measurements up to 300 VRMS, use the 10:1 attenuators on the Option 020 input card. Eight of the 10 available channels can accommodate the 10:1 divider. Each Option 020 comes configured with the 10:1 divider on channel 2. For seven additional dividers, order the 44469A accessory.

The ac converter is average responding and operates in either 3½- or 4½-digit mode.

Input Characteristics

Range	Maximum Display (4½ Digit)	4½ Digit Resolution	Input Resistance	Maximum Input Voltage
3 V	3.0100	100 μV	10MΩ ± 1%	Hi-Lo ± 30V peak
30 V	30.100	1 mV	10MΩ ± 1%	Lo terminal to earth: ± 150V peak

AC Specifications*: ± (% Reading + Counts) (90 days)

	30 Hz – 1 kHz	45 Hz – 500 Hz	Temperature Coefficient ± (%Reading + Counts)/°C 0 – 18°C, 28 – 55°C
3½ Digits	1 + 6	0.5 + 6	.01 + .7
4½ Digits	1 + 60	0.5 + 60	.01 + 7

*These specifications assume: $V_{in} \geq 0.3V$ (3V Range)
$V_{in} \geq 3V$ (30V Range)

High Voltage Divider (44469A):
Z_{in}: 1 MΩ ± 1%
$C_{in} \leq 25$ pF
Add 1% Reading error when using divider

Maximum Input Voltage:
301 V RMS (±425 V peak) Hi-Lo
±350 V peak – Hi terminal to earth.
±150 V peak – Lo terminal to earth.

Counter

Input Characteristics
Max. input voltage: 300V
Input impedance: 10 MΩ ± 1%
Min. pulse width (5V): 50 μs, 5% duty cycle min.
Sensitivity: 600 mV p-p
Counter will trigger on zero crossing and TTL waveforms

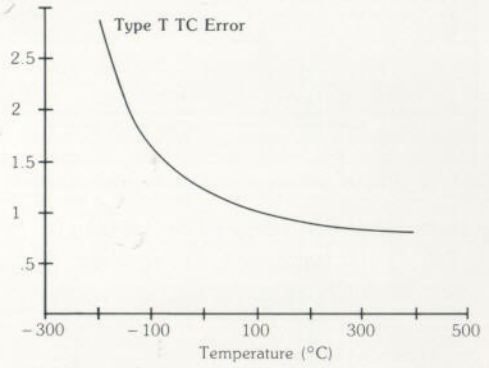
Frequency Counter Mode
Frequency Range:
1 Hz – 10 kHz (Rise time ≤ 1.5 ms)
10 Hz – 10 kHz (Rise time ≥ 1.5 ms)
Accuracy: ± (0.05% reading + 1 count)
Resolution: varies with gate time and frequency
Maximum Resolution: 65,535 counts
Gate Time: 0.1, 1 or 10 sec.

Totalize Mode
Maximum number of counts: 65,535
Minimum pulse period: 100 μS

Thermocouple Thermometer

Type T thermocouple linearization is built in. For other thermocouple types, the reference junction temperature is available. Conversions are made via 44468A Data Acquisition Pac in the 41C/CV and via the 3056DL software in the 85F.

Type T Thermocouple Linearization
Range: –200°C to +400°C
Accuracy:



(includes reference junction error, thermal offset, dvm error and curve fit. It does not include wire errors).

Temperature Coefficient: .05°C/°C (0 – 18°C, 28 – 55°C)

Reference Junction
Accuracy: ± 1°C (23°C ± 5°C)
Temperature Coefficient: .05°C/°C (0 – 18°C, 28 – 55°C)

Mainframe Reading Rates

These rates reflect the time to read and store information in the 30-reading buffer of the 3421A. They do not include computer transfer time.

	DCV, Ω		ACV			
	Auto Zero On	Auto Zero Off	Auto Zero On	Auto Zero Off	Freq.	Type T Thermocouple
Repeat Readings on the Same Channel:						
5½ digit:	2	4	–	–	0.1	0.95
(readings/sec) 4½ digit:	14	22	0.3	0.3	0.9	0.95
3½ digit:	28	35	0.4	0.4	8.0	0.95
Read Different Channels:						
5½ digit:	2	3.8	–	–	0.1	0.95
(channels/sec) 4½ digit:	13	18	0.3	0.3	0.9	0.95
3½ digit:	21	24	0.4	0.4	7.0	0.95

Option 020 Multiplexer Assembly

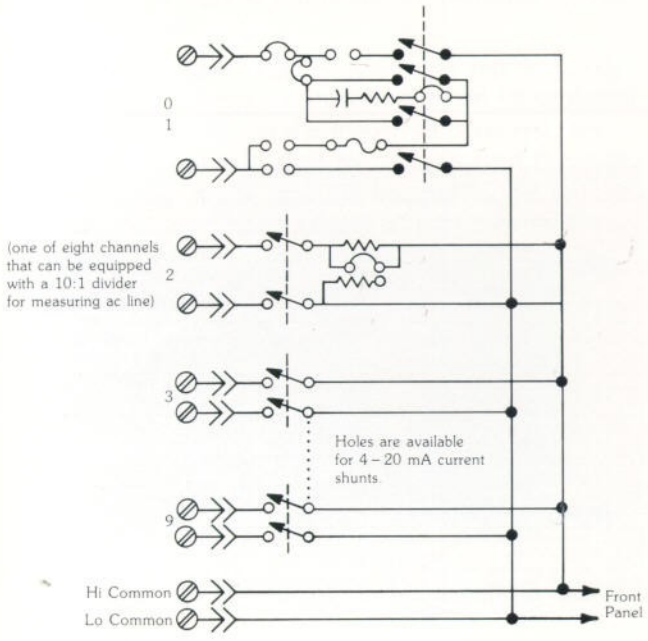
Use one Option 020 to:

- **Scan thermocouples**
- **Start small motors**
- **Close valves**
- **Scan ac line**

Use two Option 020 cards to:

- **Scan 4-wire RTDs**
- **Scan 4-wire thermistors**

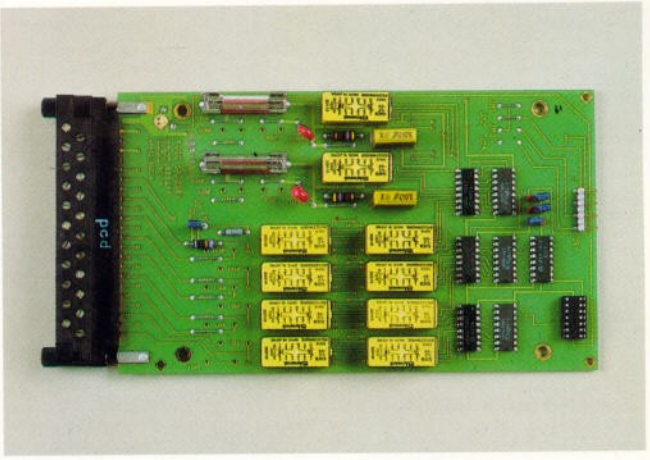
The latching relay assembly, Option 020, can multiplex input signals as well as switch high voltage loads. Each two-wire channel can switch up to ±360V dc. Up to two of the 10 relays can be configured as high voltage actuators. As actuators, two special channels can be wired and addressed separately from the other eight channels.



Thermocouples

Option 020 has a built-in temperature detector for thermocouple reference junction compensation, as well as low-thermal emf relay contacts to insure accurate thermocouple measurement.

Since all of the thermocouple compensation occurs in the controlling computer's software without affecting the input circuitry, you can use Option 020 to measure virtually any thermocouple as well as dc volts, ac volts, resistance and frequency.



AC Line Voltage

For monitoring ac line voltage, a selectable 10:1 divider is supplied on channel 2 to allow the ac converter to operate on the 30 volt range (its highest range). If you need to monitor more than one high voltage ac line, order the 44469A accessory kit. It contains seven sets of divider resistors for up to eight channels of ac line voltage monitoring per card.

RTDs

By using the CLP (close pair) command, you can synchronize two Option 020 cards to measure 4-wire RTDs and other low impedance devices.

Shunts

There are pads available on the printed circuit board for adding your own filter, adding an attenuator, or a resistor for measuring a 4 – 20 mA signal.

Actuators

The two high-voltage actuator switches have protection networks to prolong contact life and provide you with reliable operation. For low voltage switching, this network can be removed if desired, to realize higher open-circuit impedance.

Common Terminals

The 3421A front panel terminals are connected to the multiplexer common bus for use as a conventional multimeter. You can disconnect the scanner card from the common bus and use the common terminals on the scanner rear connector block to multiplex to a separate A/D, counter, etc. These terminals are also used in the single-ended scanning mode.

Option 020 Specifications

Multiplexer Mode (switches 0 – 9, 1 – 9 or 2 – 9)

Operation: break before make
Maximum Voltage:
350 V peak Hi-earth, Hi-Lo or between any two terminals within the instrument
252 V RMS ac 150 VA max
Contact Resistance: ⩽ 1.4Ω
Thermal Offset: ⩽ 3 μV with HI shorted to LO
Switch Life: 5×10^6 operations
Switch Capacitance:
Open contact: ⩽ 15 pF
Hi – Lo: ⩽ 90 pF with 1 Option 020
⩽ 130 pF with 2 Option 020
⩽ 170 pF with 3 Option 020
Channel to channel: ⩽ 30 pF
Isolation Resistance
Hi – Lo, Hi – Earth, Lo – Earth ⩾ $10^{11}\Omega$
Frequency Response
3 dB point, 50Ω source ⩾ 1 MHz
3 dB point, 1 MΩ source ⩾ 1 KHz

Actuator Mode (switches 0 & 1 only)

Maximum Voltage:
30 Vdc
252 VRMS ac
Maximum Current: 2 amps
Contact Resistance: ⩽ 1.4Ω
Switch Life: 5×10^6 operations with proper contact protection

Actuator relays do not change state when power is lost, so failsafe programming on critical processes should be designed accordingly.

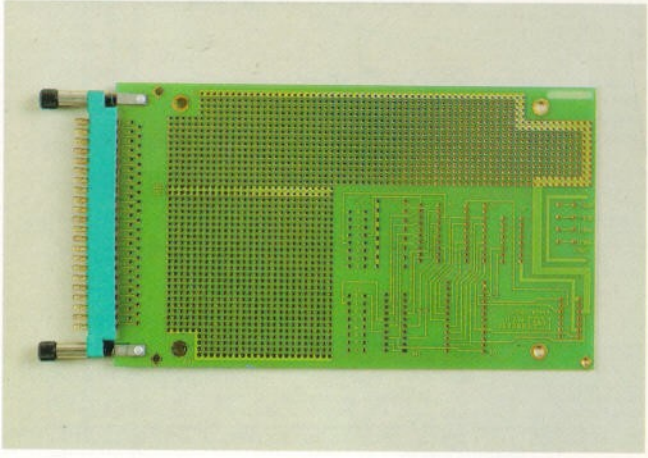
Relay Configuration as Shipped

Channel	Attenuator	Mode
0, 1	–	Actuator
2	10:1 ± 1%, 1MΩ	Scanner (ac line voltage)
3 – 9	–	Scanner

Option 040 Breadboard Assembly

Use the Breadboard Card to construct:
- **RF Switches**
- **Flowmeter Totalizers**
- **Filters and Amplifiers**
- **D to A Converters**
- **Analog Peak Detectors**

There are times when you need special functions that no single instrument can economically provide. For those cases, you can design your own custom circuitry on the 3421A Option 040 Breadboard Card. The operating manual for Option 040 explains the circuitry you will need to add to the 3421A backplane to communicate with an external 8-bit microprocessor bus.



Option 040 Specifications

Board Space: 95 sq. cm. (14.75 sq. in.)
Maximum Voltage: ±360 V
Power Available: 5 V, 35 mA; 6 V, 150 mA
Hole Sizes: .046
Grid: .100″
Connectors: 22 pin edge (solder)
Component Lead Length: ⩽ 0.25
Component Lead Height: ⩽ 0.5″
Maximum Power Dissipation: ⩽ 0.5 watts

Option 050 Digital I/O Assembly

Use the Digital Card to:

- **Monitor Level Switches**
- **Close Relays**
- **Sound Alarms**
- **Read Thumbwheel Switches**
- **Trigger the Voltmeter on an Event**
- **Start a Scan on an Event**

The dual-purpose digital assembly has both input measurement and output actuation capability. Eight separate digital input lines can sense the state of limit switches or digital logic. Each switch is isolated, so you can avoid the problems sometimes created by troublesome ground loops.

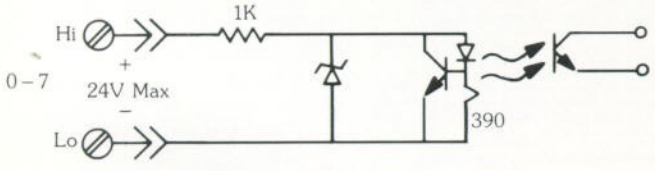
The assembly also has eight separate output switches with high current sink capacity. You can switch loads as high as 0.3 amps for alarm indications or control signals.

There's a Digital Trigger command to remotely trigger the 3421A whenever a predetermined bit or digital word is received. When the trigger bit is sensed, the entire digital word is latched so you can read the state of all the inputs at the time the interrupt occurred. You can also use Digital Trigger to start a complete scan from the channel list and store the readings in the internal buffer without computer intervention. Once the readings are stored, the computer can recall them at any convenient time.

Option 050 Specifications

INPUT SECTION

(8 identical inputs)

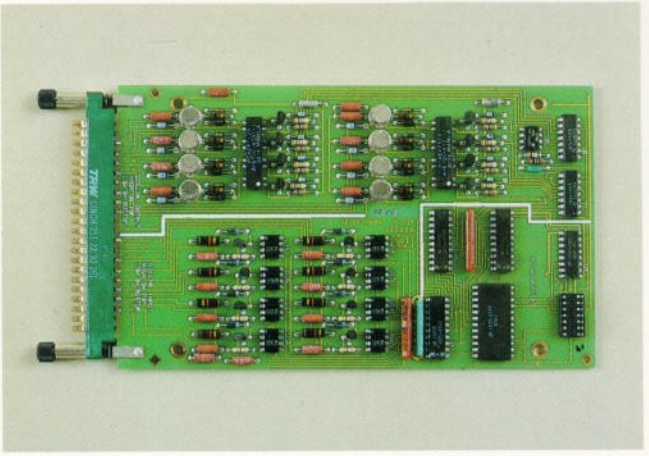


Voltage Levels:

	Min.	Max.
Low State		0.8 V
High State	2.0 V	24 V

Input Current:

	Min.	Max.
Low State		100 μA
High State	800 μA	25 mA



Logic Polarity: Positive true

Monitor Mode: (Generates SRQ)

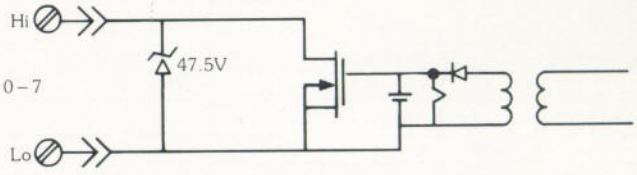
Minimum pulse width: DO: 1 mS DI: 10 mS
Trigger latch: High or low level
Trigger masking: Any combination of the 8 bits

Maximum Time From Trigger to SRQ: 1 – 10 mS

Entire 8 bits latched when trigger received.

OUTPUT SECTION

(8 identical outputs)



Input Command	Output
Logic 1	$R_o \leq 2\Omega$ $I \leq 300$ mA Power ≤ 180m watt
Logic 0	$R_o \geq 10^7\Omega$ $V_o \leq 42V$

Each bit is individually controlled and isolated.

When the 3421A internal battery becomes discharged, all output bits are cleared. When these switches are used to control a critical process, appropriate failsafe design must be used.

MAXIMUM VOLTAGES

- ±150 V peak – Hi to Earth or Lo to Earth
- ± 42 V peak between any two channels of each assembly
- ±350 V peak between any two terminals within the instrument

3421A Ordering Information

Mainframe 3421A

†‡Price

Includes 5½ digit dmm with Vdc, Vac, 4-wire ohms, channel display, battery pack, power cord, HP-IL interface, operating manual and service manual. (You must select one power line option.) $1300

Options

Input Assemblies

020	10-channel multiplexer assembly with thermocouple reference, connector block	$ 295
040	Breadboard assembly with connector block	$ 60
050	Digital I/O assembly with 8 bits, input/8 bits output and connector block	$ 295

*One 3421A mainframe accepts a maximum of 3 input assemblies.
Order additional input assemblies as field installation kits.

I/O Options

201	Add HP-IB** Interface. (This option allows the use of either HP-IB or HP-IL controller.)	$ 225
541	Add 41CV handheld calculator for 3421A. Includes HP 41CV computer, 44468A Data Acquisition Pac for fast programming of the 3421A from the 41CV, 82160A HP-IL interface module and 82182A Time Module	$ 575
561	Add 82161A Digital Cassette Drive	$ 550
562	Add 82162A Thermal Printer	$ 495

**Hewlett-Packard's Implementation of IEEE 488-1975 and ANSI MC 1.1

Power & Frequency Options

315	100 Vac, 50 Hz	Select One	N/C
316	100 Vac, 60 Hz		
325	120 Vac, 50 Hz		
326	120 Vac, 60 Hz		
335	220 Vac, 50 Hz		
336	220 Vac, 60 Hz		
345	240 Vac, 50 Hz		
346	240 Vac, 60 Hz		

Rack Mount & Manual Options

401	Side Handle Kit (5061-1171)	$ 20
907	Front Handle Kit (5061-1170)	$ 36
908	Rack Mount Kit (5061-1168)	$ 17
909	Rack Mount with Handle (5061-1169)	$ 55
910	Extra Manuals	$ 36

Field Installation Kits

44461A	Add HP-IB Interface	$ 225
44462A	10-channel multiplexer assembly with thermocouple reference, includes connector block (same as Opt. 020)	$ 295
44463A	Extra connector block for thermocouple multiplexer card	$ 35
44464A	Breadboard Assembly, includes connector block (same as Opt. 040)	$ 60
44465A	8 bit in/8 bit out digital I/O Assembly, includes connector block (same as Opt. 050)	$ 295
44466A	Extra connector block for digital card or breadboard card	$ 15
44468A	Data Acquisition Pac for 3421A/41CV	$ 100
44469A	Seven pairs of resistors for 10:1 300 Vac divider (one pair comes standard with each Option 020)	$ 15

† OEM Discounts Available
‡ Domestic U.S.A. Prices Only

Operating Information

	3421A	41CV	82161A Cassette Drive	82162A Printer	85F	16" Rack
Operating Temperature	0–55°C	0–45°C	10–40°C	0–45°C	5–40°C	—
Storage Temperature	–40 to +75°C	–20 to +65°C	–40 to +75°C	–40 to +55°C	–40 to +65°C	—
Humidity	≤ 85%, 30°C		20–80%		5–80%, 40°C	—
Min. Battery Life						
Continuous	12 hrs (HP-IL) 6 hrs (HP-IB)	34 hrs.	1.8 hrs.	1.4 hrs.	—	—
Sleep Mode	2 mos.	2 mos.	1 mo.	1 mo.	—	—
Weight kg (lbs.)	7 kg (15)	0.25 kg (.5)	0.8 kg (1.7)	0.8 kg (1.7)	9.1 (20)	18 (40)
Shipping Weight	10 (22)	2 (4.5)	2 (4.5)	2 (4.5)	16.8 (37)	32 (70)
Dimensions cm (in.)						
Length	27.2 (10.7)	14.2 (5.6)	17.8 (7)	17.8 (7)	48.3 (19)	63.7 (25.2)
Width	42.6 (16.8)	7.9 (3.11)	13.2 (5.2)	13.2 (5.2)	42 (16.5)	50 (19.8)
Height	10.2 (4)	3.3 (1.3)	6.1 (2.4)	6.1 (2.4)	15.3 (6)	42.3 (16.8)
Power Consumption	14 w	—	3 w	2.5 w	40 w	—

3056DL Ordering Information

3056DL

	†‡Price
Includes 3421A Acquisition/Control Unit with 5½ digit DVM, Vdc, Vac, Ω, counter, HP-IL interface, sliding drawer and cabinet, software levels 1 & 2 for either HP-IL or HP-IB. Up to 30 channels capacity. Computer is ordered separately	$2400

Option

020	10 channel multiplexer/actuator assembly with thermocouple reference, connector block	$ 295
040	Breadboard assembly, connector block	$ 60
050	8 bit input/8 bit output digital assembly, connector block	$ 295
201	Add HP-IB Interface to the 3421A. (This option allows the use of either an HP-IB or HP-IL controller.)	$ 225
202	Complete 3056DL system for HP-IL controller. Includes two 3421A HP-IL mainframes plus interconnecting HP-IL cable	$1300
203	Complete 3056DL system for HP-IB controller. Includes two 3421A HP-IL mainframes plus two HP-IB cards and interconnecting HP-IB cable	$1820
315	100 V, 50 Hz	
316	100 V, 60 Hz	
325	120 V, 50 Hz	
326	120 V, 60 Hz	Select One N/C
335	220 V, 50 Hz	
336	220 V, 60 Hz	
345	240 V, 50 Hz	
346	240 V, 60 Hz	
400	Delete 16″ Cabinet, Locking Drawer	–$ 850
541	Add 41CV controller for more portable applications. Includes 41CV, 3421A keyboard/logger ROM (44468A), 82160A HP-IL interface and 82182A Time module	$ 575
561	82161A Digital Cassette Drive (HP-IL)	$ 550
562	82162A Printer/Plotter (HP-IL)	$ 495
910	Extra set of 3056DL software	$ 250

Computer

Order either the 85F or 85F Option 006

	To operate the 3056DL software, you must have all 3 items (85, Extra Memory, Advanced Programming ROM)	
85F	Computer with CRT, Keyboard, tape drive, graphics, 16K memory, HP-IB Interface Card (82937A), I/O ROM (00085-15003), ROM Drawer (82936A)	$3485
85F Opt 006	Same as 85F, but with HP-IL Interface Card (82938A) in place of HP-IB Card	$3385
82903A	Extra 16K memory	$ 195
00085-15005	Advanced Programming ROM	$ 165

Other Products Available

11096B	500 MHz RF Probe
34118A	Test Lead Kit
10833A	1 Meter HP-IB Cable
10833B	2 Meter HP-IB Cable
10833C	4 Meter HP-IB Cable
10833D	0.5 Meter HP-IB Cable
82167A	0.5 Meter HP-IL Cable
82167B	1 Meter HP-IL Cable
82167D	5 Meter HP-IL Cable
44468A	3421A Data Acquisition Pac for 41CV to allow fast programming of the 3421A Acquisition/Control Unit from the HP 41C or HP 41CV. (One 44468A comes with each 3421A, Option 541.)
82160A	HP-IL Interface for 41C/CV
82166A	HP-IL to GPIO Converter
82938A	HP-IL Interface for HP Series 80 Computers
82153A	Wand
82045A	Extra printer paper for 82162A
82176A	Extra cassettes for 82161A
3468A	HP-IL Digital Multimeter
82120A	Rechargeable Battery Pac – 41C/CV
82059B	120 Volt charger (for 82161A, 82162A, etc.)
82066B	220 Volt European charger (for 82161A, 82162A, etc.)
82182A	Time Module for 41CV
82170A	Quad memory Module for 41C

† OEM Discounts Available

‡ Domestic U.S.A. Prices Only

Key Features

The 3421A Data Acquisition/Control Unit

Measurement Integrity

- 1 μV autoranging 300,000 count A/D
- VDC, VAC, Ohms, Frequency, Thermocouple Reference Junction
- Type T linearization built in
- Electronic calibration

Versatility

- Operates with 41CV, dedicated ROM
- 8 bit in/8 bit out digital assembly optional
- Optional 10-channel multiplexer and actuator assembly with low thermal relays
- Breadboard assembly optional
- 30-reading storage
- 30 channel sequence list
- High level instructions built in
- HP-IL built in, HP-IB + HP-IL optional
- Removable field wiring connectors
- Up to 30 differential or 56 single-ended channels

Battery Power

- Rechargeable battery is standard
- Sleep mode for extended battery life

The 3056DL Data Logger

The features of TWO 3421A Data Acquisition/Control Units Combined, PLUS:

- HP 85F computer with graphics, tape drive, printer
- Menu entry OR Subroutine software
- 16" locking cabinet with drawer
- Adaptive scanning
- Graphics analysis
- User definable functions
- HP-IL for low cost or HP-IB for larger systems

For more information, call your local HP Sales Office or nearest Regional Office: • Eastern (201) 265-5000; • Midwestern (312) 255-9800; • Southern (404) 955-1500; • Western (213) 970-7500; • Canadian (416) 678-9430. Ask the operator for instrument sales. Or write Hewlett-Packard, 1501 Page Mill Road, Palo Alto, CA 94304. **In Europe:** Hewlett-Packard S.A., 7, rue du Bois-du-Lan, P.O. Box, CH 1217 Meyrin 2, Geneva, Switzerland. **In Japan:** Yokogawa-Hewlett-Packard Ltd., 29-21, Takaido-Higashi 3-chome, Suginami-ku, Tokyo 168.

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